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THE MAY MEETING OF THE MARYLAND-VIRGINIA-DISTRICT OF COLUMBIA SECTION.

The ninth regular meeting of the Maryland-Virginia-District of Columbia Section of the Mathematical Association of America was held in the Drafting Hall of the U. S. Capitol, Washington, D. C., on May 7, 1921. The meeting consisted of two sessions with Professor L. S. Hulburt presiding.

The attendance was fifty-five including the following thirty-four members of the Association: O. S. Adams, J. J. Arnaud, R. N. Ashmun, H. G. Avers, Sarah Beall, A. A. Bennett, G. A. Bingley, C. C. Bramble, P. Capron, A. Cohen, G. H. Cresse, F. W. Darling, L. S. Dederick, A. Dillingham, H. English, J. B. Eppes, A. Hall, W. M. Hamilton, W. E. Heal, L. S. Hulburt, W. D. Lambert, A. E. Landry, J. J. Luck, E. S. Mayer, L. N. Morscher, C. A. Mourhess, F. D. Murnaghan, J. R. Musselman, O. J. Ramler, C. H. Rawlins, Jr., R. E. Root, C. A. Shook, T. McN. Simpson, Jr., C. E. Van Orstrand.

A luncheon was served to the members and their guests by the Coast and Geodetic Survey and the International (Canadian) Boundary Commission. Action was taken authorizing the secretary-treasurer to prepare an amendment to the constitution giving Virginia representation on the executive committee, this amendment to be submitted to the members of the Section for final action at the next meeting. The following officers were elected for 1921–1922: O. S. ADAMS, Chairman; G. R. CLEMENTS, Secretary-treasurer; F. D. MURNAGHAN, Member of the executive committee.

The next meeting will be held at Johns Hopkins University, Baltimore, Md., probably early in December.

The following papers were presented:

(1) Address of welcome by Colonel E. L. JONES, Director, United States Coast and Geodetic Survey;

(2) "Relations between the metric and projective theories of curves" by Professor T. McN. SIMPSON, Jr., Randolph-Macon College, Ashland.

(3) "Shearing stress in thick cylinders" by Professor R. E. ROOT, U. S. Naval Academy;

(4) "Mechanical prediction of tides" by Mr. W. D. LAMBERT, Coast and Geodetic Survey;

(5) "Suggestions as to improvements in text-books on mathematics" by Professor ANGELO HALL, U. S. Naval Academy;

(6) "A geometrical problem in maxima and minima" by Professor F. D. MURNAGHAN, Johns Hopkins University;

(7) "On Fermat's last theorem" by Mr. W. E. HEAL, Coast and Geodetic Survey;

(8) "An arithmetical study of regular solids" by Doctor G. H. CRESSE, U. S. Naval Academy;

(9) "An elementary method of computing logarithms" by Professor L. S. DEDERICK, U. S. Naval Academy;

(10) "A note on the history of non-euclidean geometry" by Professor ABRAHAM COHEN, Johns Hopkins University;

(11) "Imaginary points in geometry" by Professor A. A. BENNETT, Technical Staff, Army Ordnance.

Abstracts of papers numbered in accordance with the above list of titles are given below.

2. Professor Wilczynski has developed a convenient machinery for the study of projective differential properties of plane and space curves by the use of linear differential equations of the third and fourth order respectively. He has also shown that specialization of the variables employed and of the transformations permitted, makes it possible to secure metric results in a similar manner. Professor Simpson undertook briefly to indicate the method of Professor Wilczynski and to give some metric results obtained by developing it in the case of space curves defined by their intrinsic equations. He considered a number of osculants of space curves and suggested how they might be regarded as images of the radii of curvature and torsion and their derivatives. His results are published in a paper issued by the University of Chicago libraries.

3. Professor Root discussed the stresses and strains in thick cylinders, particularly under conditions present in gun tubes. The usual theory is based on a thick, hollow, right circular cylinder, with uniform external and internal pressure, and with uniform normal stress on the ends. The stress distribution at a transverse section is expressed by two fundamental equations known as Lamé's laws. Professor Root raised a question as to the application of these laws in the presence of such varying pressures as are produced in built-up guns. He showed that if internal and external pressure vary uniformly from one end of the cylinder to the other, then the stress distribution at any transverse section is given by Lamé's laws. Otherwise, these laws do not hold, the normal stress is not uniform over the section and shearing stress is present, radial on transverse planes and longitudinal on tangential planes.

4. Mr. Lambert's paper on the mechanical prediction of tides gave a brief account of the principles underlying the harmonic analysis of tidal data and of the two tide-predicting machines of the Coast and Geodetic Survey, which were exhibited later in the day to those attending the meeting. The height of the tide is expressed as the sum of a series of terms of the form $A \cos (at + \alpha)$, where t is the time from the beginning of the year for which predictions are to be made; the quantity a, called the "speed," is obtained from astronomical considerations; the quantities A and α, the former being the amplitude of the component oscillation and the latter its phase at the beginning of the year of prediction, are obtained for any given port from a discussion of the observations there by the methods of the harmonic analysis. The tide-predicting machines sum these cosine terms mechanically. The smaller or Ferrel machine, now no longer used, is said to do the work of about 40 computers. The larger machine provides for nearly twice as many cosine terms as the Ferrel machine and gives the time-derivative of the heights as well as the heights themselves, thus indicating—by

the zero values of the derivative—the exact times of high or low water. The larger machine may be said to do the work of from 80 to 100 computers.

5. The many failures to pass the examinations in arithmetic, algebra, and plane geometry, for entrance to the Naval Academy, show the low standards of mathematical study obtained in our high schools. Professor Hall suggested three remedies: (*a*) the weeding out of incompetent pupils, (*b*) the securing of good teachers, and (*c*) the improvement of text-books.

6. Dr. Murnaghan discussed the problem of the determination of the points in space the sum of whose distances, taken positively or negatively, from the four vertices of a tetrahedron is a minimum (Fermat). If tetrahedral coördinates are used, and we avail ourselves of the focal transformation $y = 1/x$, there are eight Fermat points y corresponding to the eight intersections of the three quadrics $x_1^2 + x_2^2 + 2c_{12}x_1x_2 = x_3^2 + x_4^2 + 2c_{34}x_3x_4$, etc., where c_{rs} is the cosine of the internal dihedral angle between the faces r and s of the tetrahedron. The points x are such that their pedal tetrahedra have opposite edges equal, i.e., have *congruent faces*. In the plane Fermat problem (cf. this MONTHLY, *1920*, 38–41) there are two points y and two points x; these latter are the Hessian points whose pedal triangles are *equilateral*. Reference is made to a forthcoming paper by C. M. Sparrow in the *American Journal of Mathematics*.

7. Mr. Heal's paper gave a short review of various methods that have been proposed for the demonstration of the theorem, paying particular attention to that of Kummer and expressing the belief that this method cannot lead to a general demonstration. Other methods were suggested as possible for leading to a solution of the problem.

8. Dr. Cresse obtained the number of vertices of a regular polyhedron by comparing the two following expressions for the sum of the face angles: $(V - 2)2\pi$, which holds for all polyhedrons, and $V \cdot f \cdot (s - 2)/s \cdot \pi$, which holds for a regular polyhedron, in which f faces each having s sides meet in each vertex. The multiplicity of the other elements follows at once. Similarly, in 4-space, the ratio of V to E for a regular polyhedroid is obtained by comparing two independent expressions for $\Sigma P - 2\Sigma D$, where P is the magnitude in spherical degrees of each polyhedral angle and D is the magnitude in circular degrees of each dihedral angle of the bounding polyhedron. The multiplicity of all the other elements in terms of V follows at once for the six regular polyhedroids of 4-space.

9. The purpose of Professor Dederick's paper was to present a method of computing the common logarithm of any number to the base 10, which is sufficiently elementary to be easily intelligible to a student just taking up the study of logarithms. The method is based solely on the property of a logarithm as an exponent of 10 and involves nothing more advanced than the binomial theorem for positive integral exponents.

10. Professor Cohen reviewed a recent book by Dr. G. B. Halsted (*1921*, 28–30). Easy access to this work will now enable one better to estimate the place which Saccheri deserves to occupy in the history of the development of non-euclidean geometry.

11. Professor Bennett sketched briefly some of the reasons which have led to the introduction of imaginary points into geometry. He then showed that for some purposes a "complex" point, where the coördinates are complex numbers of algebra, is not the only convenient generalization beyond the set of real points of space. Another generalization involving a special class of square matrices with quaternionic elements satisfies the usual vectorial requirements, and may be used to define a "space" in which the notion of distance continues to have its characteristic properties. The "real" points of such a space constitute an ordinary real space, so that one may interpret familiar geometric loci as having not only real points but further points in such a generalized space.

O. S. ADAMS, *Secretary-Treasurer.*

THE JUNE MEETING OF THE MINNESOTA SECTION.

The regular meeting of the Minnesota Section was held at the College of Saint Thomas, St. Paul, Minn., on Saturday, June 4. The attendance was twenty-one, including the following thirteen members of the Association:

R. M. Barton, W. O. Beal, W. H. Bussey, H. H. Dalaker, Gladys Gibbens, W. L. Hart, Dunham Jackson, R. A. Johnson, Arvid Reuterdahl, Minna Schick, F. J. Taylor, Ella Thorp, Vera L. Wright.

Dinner was served at six o'clock with the College of Saint Thomas as host. At a business meeting which followed the following officers were elected: Chairman, Professor REUTERDAHL; Secretary-treasurer, Professor BARTON; Members of the executive committee, Professor DALAKER, Miss GIBBENS, Professor C. H. GINGRICH. The report of the Secretary-treasurer was approved as presented.

The following papers were presented:

(1) "Mathematical induction" by Professor W. H. BUSSEY, University of Minnesota.

(2) "Constructions with ruler and circular disk" by Professor R. A. JOHNSON, Hamline University.

(3) "Some problems in medicine which the mathematician must solve" by Dr. R. E. SCAMMON, University of Minnesota (by invitation).

Abstracts of the papers follow below, the numbers corresponding to the numbers in the list of titles.

1. Ordinary mathematical induction may be described briefly as an argument from n to $n + 1$. Professor Bussey's note called attention to some generalizations of ordinary mathematical induction of which the most simple may be described as an argument from n and $n + 1$ together to $n + 2$.

2. Professor Johnson discussed the somewhat well-known proposition that all constructions which can be effected with ruler and compasses are possible with a ruler and a circular disk whose center is not given.

3. Dr. Scammon indicated how the applications of mathematics to the problems of the medical sciences may be divided roughly in two classes. Of